Serial No. 27

LIMENTARY

IMPERIAL BUREAU OF AGRICULTURAL PARASITOLOGY

NOTES AND MEMORANDA

No. 11

Recent Developments in the Control of *Heterodera marioni*

Commonwealth Institute of Helmintholog
The White House,
103, St. Peters Street,
ST. ALBANS, Herts., AL1 3EW, England

WINCHES FARM DRIVE, HATFIELD ROAD
ST. ALBANS, ENGLAND

1936

Price 1/- Post Free

Recent Developments in the Control of *Heterodera marioni*.

THE monograph published by this Bureau in 1931 under the title : " The root-infesting eelworms of the genus *Heterodera*" * had an introductory section dealing, *inter alia*, with methods of control. In the past five years there have been several new attempts to establish reliable control methods, particularly in the case of *Heterodera marioni* (=*H. radicicola*) which is such an important pest of tropical crops. It has therefore been decided to issue a list of references to recent literature, restricting the list to papers dealing with the control of *H. marioni*.

In order to increase the value of the list, it is prefaced by a brief summary. The different methods of control have been based upon the reactions of this eelworm to various factors in the environment, physical, chemical or biological, and these will serve as convenient headings in the summary that follows.

I. PHYSICAL FACTORS.

(*a*) *Temperature.*

Tyler (1933) reports that all stages in the life-cycle of the eelworm are killed at 0°F. A temperature of 135°F. kills all stages instantly, 120°F. kills in 10 minutes and 110°F. kills in 2 hours. Jones (1932) has found that the optimum soil temperature for eelworm activity lies between 77°F. and 86°F.

(*b*) *Hot water treatment.*

Hoshino & Godfrey (1933) exposed larvae and egg masses of *H. marioni* to hot water treatment at a wide range of temperatures. Larvae were killed in one second at 127·4°F. and in 2 hours 7·5 minutes at 104°F. At the same temperatures the survival times for the more resistant eggs were

* " The Root-infesting Eelworms of the Genus *Heterodera*. A Bibliography and Host List." St. Albans, viii + 99 pp., 2 plates.

37·5 seconds and 4·5 days respectively. In actual practice higher temperatures must be used so that a lethal temperature may reach eelworms embedded in soil or in plant tissues.

In applying hot water treatment to infested paeony roots Brown (1934) found that 30 minutes at 120°F. was satisfactory.

(*c*) *Moisture and Desiccation.*

Jones (1932) found that few eelworms developed in soil containing 100% of its moisture capacity, the optimum degree of moisture apparently lying between 60 and 80%. They failed to survive for more than a few weeks in air-dried soil.

Godfrey & Hoshino (1933) found that complete dryness was lethal to larvae in 3 minutes, and to egg-masses in times varying up to 2 hours. They also found that exposure to 90% humidity was fatal to larvae in 30 minutes and to eggs in 6 hours. These tests were made with eggs and larvae experimentally isolated from their natural environment.

Using soil inoculated with eggs and larvae Godfrey, Oliveira & Gittel (1933) found that all forms would survive for upwards of 20 weeks in soil allowed to dry without stirring, in soil frequently stirred to hasten drying and in soil with an excess of moisture over the " moisture equivalent." The following conditions hastened the death of eelworms :—(i) excess moisture in which the larvae exhaust their vitality by continuous activity, (ii) conditions fluctuating between excess moisture and air-dryness, (iii) moist soil in sealed containers permitting rapid decay of organic matter. These authors recommend that woody roots should be exposed to the sun for several days before being ploughed in.

Fajardo & Palo (1933) writing on *H. marioni* in the Philippines report that air desiccation for 25 to 35 days was effective in destroying all nematodes in infected soil.

(*d*) *Flooding.*

Jones (1932) found that continuous flooding for 28 days was not effective in destroying the eelworm. Brown (1933) used large scale plots for prolonged periods and tested his results by laboratory observation. He found that flooding for 4 to 6 months killed the larvae but not the eggs.

Eelworms survived in soil flooded for 12 months and actually 22½ months were necessary to kill all stages.

Fajardo & Palo (1933) report that flooding for 35 to 40 days decreased but did not destroy the infection.

(*e*) *Light.*

Godfrey & Hoshino (1933) found that ultra-violet radiation was lethal to both eggs and larvae. The combined effects of sunlight, heat and drying caused the death of the eelworms in a very short time.

(*f*) *Hydrogen-ion concentration.*

Using natural soils, and soils treated with sulphuric acid and sodium hydrate respectively, Godfrey & Hagan (1933) observed the effects of hydrogen-ion concentrations between pH 3·5 and pH 8·5. All they could find was a slight reduction at pH values over 7·6.

II. Chemical Factors.

(*a*) *Carbon disulphide.*

Guba (1932) used an emulsion of 68% carbon disulphide, 26% water and 6% rosin fish oil soap, diluting this with water in the ratio 1 : 50 and applying to greenhouse beds at the rate of one gallon per square foot. This gave satisfactory control at moderate cost and was followed by normal yields. The larger root masses should be removed from the soil and the soil should be kept damp and warm for some weeks before treatment. Replanting is possible one week later.

Tyler (1933) also claims good results from this substance.

Godfrey (1935) in field experiments found that carbon bisulphide at the rate of 750 lbs. per acre gave a yield increase of 29·3% with 48% eelworm reduction.

(*b*) *Chloropicrin.*

Godfrey, Oliveira & Hoshino (1934) have made laboratory, greenhouse and small field tests with chloropicrin. They were able to eliminate 99% of the eelworms in closed containers. Results in the field tests were of course less satisfactory but still gave a good measure of control. They found that rates of application should be from 250 to 400 lb. per acre and that

points of application should be not more than 18 inches apart. The soil should be of good tilth and without excessive moisture. As far as possible the gas should be confined within the soil by an impervious cover. It is essential that infected roots should have decayed before the application.

Godfrey (1935) gives further data on the results of treating soil subsequently covered with tar-impregnated pineapple mulching paper :

	Rate lb. per acre	Yield increase %	Nematode reduction %
Expt. 1	130	26	94·5
	160	31·4	94·4
Expt. 2	150	52·2	83
	170	52·3	90

(*c*) *Cyanogas.*

As reported by Godfrey (1935) this is not as effective as carbon bisulphide or chloropicrin.

(*d*) *Formalin.*

Newton & Bosher (1933) used a 1 per cent. formalin solution at the rate of 1 gallon per 50 cubic feet of soil. This effectively controlled the eelworm and appeared to stimulate the growth of tomato seedlings from seed sown immediately after treatment.

(*e*) *Potassium xanthate.*

This has been used by Godfrey (1935) but is less valuable than chloropicrin.

(*f*) *Sulphur.*

Poole (1932) used ground sulphur on infected soil in Carolina. At the rates of 400 and 600 lb. per acre no infections were found on a susceptible variety of sweet potato. At the rate of 200 lb. per acre the infection was comparatively light.

III. Biological and Cultural Factors.

(*a*) *Resistant crops.*

Heterodera marioni occurs on a very large number of wild and cultivated plants so that it is difficult to arrange a rotation of resistant crops.

However, Tyler (1933) gives lists of plants reported as resistant, plants said to give a good crop even when infested, and plants reported as not seriously injured. He finds that rotation with resistant crops combined with control of weeds allows one susceptible crop to be grown every two or three years.

In the Philippines Fajardo & Palo (1933) found the following crops to be resistant : rice, corn, garlic, onion, peanuts, sincamas and seguidilla. They found no evidence of the formation of biologic strains.

(*b*) *Trap crops.*

Godfrey & Hoshino (1934) describe small-scale experiments, and Godfrey & Hagan (1934) experiments on a field scale designed to test the practicability of eradicating *H. marioni* by means of trap crops. On a small scale, tomato plants withdrew 98% of eelworms in a single planting, while cowpeas withdrew up to 30%. Results were less satisfactory in the field experiments. Trap crops can be left in the ground for only a short time without intensifying the eelworm population, hence the lower layers of soil were not cleared by the trap crop. Two plantings of the trap crop reduced the eelworms by over 90% but total eradication was not effected even after 16 plantings. The authors conclude that complete fallow for an equal period of time was just as satisfactory.

(*c*) *Cultural practice.*

Le Roux & Stofberg (1935) tested the effects of 5 cultural methods on 20 small plots of infected land, size 20 by 30 feet each. The methods, which were applied for 11 months, were as follows :—

(i) planted with susceptible crops ;

(ii) unplanted and kept free from weeds by hoeing and ploughing ;

(iii) planted with resistant crops ;

(iv) unplanted and unweeded ;

(v) unplanted but kept free from weeds by hoeing.

After this treatment an indicator crop of tomatoes was grown on all plots. Results showed that the second method, clean cultivating with ploughing, was the most satisfactory. Some measure of control was also given by the third and fifth methods.

References.

Brown, L. N., 1933.—" Flooding to control root-knot nematodes." *J. Agric. Res.*, xlvii (11), 883–888.

Brown, N. A., 1934.—" Control of crown and root rot of paeonies in America." *Gardeners' Chron.*, xcv (2460), p. 114.

Fajardo, T. G. & Palo, M. A., 1933.—" The root-knot nematode, *Heterodera radicicola* (Greef) Müller, of tomato and other plants in the Philippine Islands." *Philippine J. Sci.*, li (4), 457–481.

Godfrey, G. H., 1935.—" Experiments on the control of the root-knot nematode in the field with chloropicrin and other chemicals." *Phytopathology*, xxv (1), 67–90.

Godfrey, G. H. & Hagan, H. R., 1933.—" Influence of soil hydrogen-ion concentration on infection by *Heterodera radicicola* (Greef) Müller." *Soil Sci.*, xxxv (3), 175–184.

Godfrey, G. H. & Hagan, H. R., 1934.—" A study of the root-knot-nematode trap crop under field soil conditions." *Phytopathology*, xxiv (6), 648–658.

Godfrey, G. H. & Hoshino, H. M. 1933.—" Studies on certain environmental relations of the root-knot nematode, *Heterodera radicicola*." *Phytopathology*, xxiii (1), 41–62.

Godfrey, G. H. & Hoshino, H. M., 1934.—" The trap crop as a means of reducing root-knot nematode infestation." *Phytopathology*, xxiv (6), 635–647.

Godfrey, G. H., Oliveira, J. M. & Gittel, E. B. H., 1933.—" The duration of life of the root knot nematode, *Heterodera radicicola*, in soil subjected to drying." *Soil Sci.*, xxxv (3), 185–195.

Godfrey, G. H., Oliveira, J. & Hoshino, H. M., 1934.—" Increased efficiency of chloropicrin for nematode control with better confinement of the gas." *Phytopathology*, xxiv (12), 1332–1346.

Guba, E. F., 1932.—" Carbon disulfide emulsion for the control of the root-knot nematode." *Bull. Massachusetts Agric. Exp. Sta.*, No. 292, 16 pp.

Hoshino, H. M. & Godfrey, G. H., 1933.—" Thermal death point of *Heterodera radicicola* in relation to time." *Phytopathology*, xxiii (3), 260–270.

Jones, L. H., 1932.—" The effect of environment on the nematode of the tomato gall." *J. Agric. Res.*, xliv (3), 275–285.

Le Roux, J. C. & Stofberg, J. F., 1935.—" Cultural methods for the control of the root-knot nematode." *Farming in S. Africa*, x (109), 150–154.

Newton, W., & Bosher, J. E., 1933.—"The tomato root knot disease." *Sci. Agric.*, xiii (9), 594–595.

Poole, R. F., 1932.—" Root-knot in North Carolina." *Plant Disease Reporter*, xvi (2), p. 17.

Tyler, J., 1933.—" The root-knot nematode." *Circ. California Agric. Exp. Sta.*, No. 330, 34 pp.

Digitized by the Internet Archive
in 2025

https://archive.org/details/notes-memoranda-agricultural-parasitology_1936_11

Publications of the Imperial Bureau of Agricultural Parasitology

(IMPERIAL AGRICULTURAL BUREAUX)

The Scope and Aims of the Imperial Bureau of Agricultural Parasitology.
By B. G. Peters, 6 *pp.*; free on application.

Bibliography of Helminthology.
For the years 1930, 1931, 1932, 1933.
Library Edition, bound in cloth: 10*s.* 6*d.*, *stiff paper cover only:* 8*s. each.*

The Root-infesting Eelworms of the Genus Heterodera:
A Bibliography and Host-list; *viii*+99 *pp.*, 2 *plates.*
Library Edition, bound in cloth: 8*s.* 6*d.*, *stiff paper cover only:* 6*s.*

***The Helminth Parasites of Common Rats.**
By J. N. Oldham. 42 *pp.*, 2*s.*

***The Genus *Anguillulina* Gerv. & v. Ben., 1859, vel *Tylenchus* Bastian, 1865.**
By T. Goodey, 106 *pp.*, 117 *figs.*, 6*s.*

The Bursate Lungworms of Domesticated Animals.
By T. W. M. Cameron, 36 *pp.*, 5*s.*

Recent Researches on Helminth Immunity.
By Phyllis A. Clapham, 20 *pp.*, 3*s.*

The Pathology and Aetiology of Plant Lesions caused by Parasitic Nematodes.
By T. Goodey, 34 *pp.*, 5*s.*

The Bearing of the Physiology of Parasitic Nematodes on their Treatment and Control.
By G. Lapage, 21 *pp.*, 3*s.*

Notes and Memoranda.

*No. 1. On the Eelworm *Heterodera schachtii* as a Potential Danger to the Sugar-beet Industry in Britain. 8 *pp.*, 1*s.*
*No. 2. Hand-list of Helminth Parasites of the Rabbit. 12 *pp.*, 1*s.*
*No. 3. The Kidney-worm of Swine: *Stephanurus dentatus.* 12 *pp.*, 1*s.*
*No. 4. The Helminth Parasites of Deer. 32 *pp.*, 2*s.*
*No. 5. Differential Diagnosis of Plant-parasitic Eelworms. 12 *pp.*, 1*s.*
No. 6. "Potato Sickness" and the Eelworm *Heterodera schachtii.* 22 pp., 2*s.*
No. 7. Helminthology in its Application to Livestock. By T. W. M. Cameron, 8 *pp.*, 1*s.*
No. 8. Helminthology in its Application to Agriculture and Horticulture. By M. J. Triffitt. 6 *pp.*, 1*s.*
No. 9. Helminths in the Biological Control of Insect Pests. By J. N. Oldham, 6 *pp.*, 1*s.*
*No. 10. The Helminth Parasites of Marsupials. By J. N. Oldham, 62 *pp.*, 4*s.*
No. 11. Recent Developments in the Control of *Heterodera marioni.* 6 *pp.*, 1*s.*

* These have also appeared in the *Journal of Helminthology.*

Printed in England by SOUTH ESSEX RECORDERS, LTD., High Road, Ilford, Essex, and
Published by THE IMPERIAL BUREAU OF AGRICULTURAL PARASITOLOGY, St. Albans.